MATERIALISM AND MODERN PHYSIOLOGY OF THE NERVOUS SYSTEM

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BY

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G. P. PUTNAM'S SONS

NEW YORK
27 WEST TWENTY-THIRD STREET

LONDON
24 BEDFORD STREET, STRAND

The Knickerbocker Press

1892

Electrotyped, Printed, and Bound by
The Knickerbocker Press, New York
G. P. Putnam's Sons

ILLUSTRATIONS.

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PRELIMINARY to any discussion of questions about mind, a definition of the terms to be used is no less needful than settling the points of the compass before seeking the way out of a great forest. Otherwise the unconsciously varying meaning of words may lead us to repeat mentally the experience of two friends of mine, who, after starting on a foggy morning to row across a lake, began to think it was high time that they made the opposite shore, when suddenly the boat ran against the same stake from which they had loosed it an hour before. Just so, in our present undertaking, ill-defined words may cause us to glide along anywhere but to

* Address before the Philosophical Faculty of Columbia College, February 16, 1892

some definite gain for our trouble; and hence, though at the risk of being tedious, I prefer to begin with quoting at length from the writings of some eminent authorities in modern biological science what they say about materialism.

This term or name appears, of late years, to be an offense to nearly every recognized authority in biology, and no anti-materialist could wish for more conclusive refutations of its supposed doctrines than those which he may read in numerous published essays or discourses by such men as Huxley, Tyndall, Romanes and others. But soon he discovers that a landing is not yet, for when he asks these guides of science what they have to offer instead of materialism, or as an alternative to it, he finds himself transferred from one round of speculation to another, with a steadily increasing indefiniteness of outline and of view, until he experiences an uneasy feeling that there has been a curious mistake somewhere and that most likely, at the very start, in the meaning of the term "materialism" itself.

I will begin, therefore, with Dr. George Romanes, whose essays on biological subjects had given me an impression which made me curious to read what he had to say in an article by him, in the *Contemporary Review*, Volume XII., entitled "The Fallacy of Materialism." Premising that when once the invariable association between material changes and mental changes is recognized, there arises the question as to the nature of this constant association, Dr. Romanes proceeds to discuss the question, Can the material changes in the brain cause the mental changes? The affirmative to this he assumes to be the contention of materialism, and he begins by summarily ruling it out of court as having no case to argue. For he says that where the question becomes one not as to the fact of the association, but as to its nature, Philosophy, which must have regard to the facts of mind, no less than to those of matter, must pronounce that the hypothesis is untenable, for the hypothesis of this association being one of causality, acting from neurosis to psychosis—that is, from ner-

vous structure to mental processes—cannot be accepted without doing violence not merely to our faculty of reason, but to our very idea of causation itself. For our idea of causation is not derived from without, but from within, and what we call the evidence of physical causation is really only certain wholly mental modifications following one another in definite sequence. Hence, we can have no evidence of causation proceeding from object to subject. The mind, therefore, cannot prove its own causation from matter or motion, because all evidence of that must itself be mental evidence and nothing but mental, and hence it is as impossible for the mind thus to prove its own causation as it is for water to rise above its source.

Having thus opened the argument, as the lawyer's custom is, by showing that the materialists really have no case at all, Dr. Romanes agrees, however, to allow them a chance to say something, by remarking that they are fond of asserting that the evidence of causation from neurosis to psychosis is as good as such evidence can be proved in any

other case. But, without considering the above-mentioned fundamental difficulty that there can be no such real evidence at all, he says the statement can be proved to be untrue by treating the problem on the lower ground of the supposed analogy itself. For the only resemblance between this supposed case of causation and all other cases of causation consists in the invariability of the correlation between cerebral processes and mental processes. In all other points the analogy fails. For in all cases of recognized causation there is a perceived connection between the cause and effect; the antecedents are physical and the consequents are physical. But in the case before us there is no perceived or even conceivable connection between cause and effect, for the causes are supposed to be physical and the effects mental. And the antithesis pointed out is alone sufficient to separate, *toto cælo*, the case of this supposed causation from that of all cases of causation recognized.

Dr. Romanes then quotes, in illustration of this statement, the following passage from

Dr. Allman's presidential address before the British Association of Science:

Dr. Allman says: "If we could see any analogy between thought and any one of the admitted phenomena of matter, we should be justified in admitting the conclusions of materialism as the simplest, and as affording a hypothesis most in accordance with the comprehensiveness of natural laws. But between thought and the physical phenomena of matter there is not only no analogy, but no conceivable analogy, and the obvious and continuous path which we have hitherto followed up in our reasonings from the phenomena of lifeless matter through those of living matter here comes suddenly to an end. The chasm between unconscious life and thought is deep and impassable, and no transitional phenomena can be found by which, as a bridge, we may space it over."

In further illustration of the want of correspondence between the alleged material cause and the mental effect, Dr. Romanes quotes these words from Prof. Tyndall: "The passage from the physics of the brain

to the corresponding facts of consciousness is unthinkable. Granted that a definite thought and a definite molecular action in the brain occur simultaneously, we do not possess the intellectual organ, nor apparently any rudiment of the organ, which would enable us to pass by a process of reasoning from the one phenomena to the other. Were our minds and senses so expanded, strengthened and illuminated as to enable us to see and feel the very molecules of the brain; were we capable of following all their motions, all their groupings, all their electrical discharges, if there be such, and were we intimately acquainted with the corresponding changes of thought and feeling, we should probably be as far as ever from the solution of the problem.—How are these physical processes connected with the facts of consciousness? The chasm between the two classes of phenomena would still remain intellectually impassable."

The next objection to materialism which Dr. Romanes finds is that, in all cases of recognized causation, there is a perceived equiv-

alency between cause and effect. But, as between matter and motion on the one side and feeling and thought on the other, there can be no such equivalency conceivable. Some few materialists, he says, have sought to meet the difficulty in the only way it can be met, by boldly asserting the possibility of thought and energy being transmutable.

On this view thought becomes a mode of motion and takes its rank among the forces as identical in nature with heat, light, electricity and the rest. But this view he regards as also inherently impossible. Mind presents absolutely no point of real analogy with motion, because involved with the essential idea of motion is the idea of extension, for motion only means translation in space of something itself extended. But thought, as far as we possibly can know it, is known and distinguished by the very peculiarity of not having extension, and therefore for motion to become thought it must cease to be motion, and therefore cease to be energy.

Thought, therefore, instead of being the equivalent of so much energy, destroys energy,

and would thus constitute a unique exception to the otherwise universal law of the conservation of energy in space. He also asks how not only the equivalency between brain motion and thought, in general, is to be demonstrated, but also what equivalency there can be between different minds in particular cases. Was the difference due to increased cerebral motion which separates the thoughts of Shakespeare and of Darwin from those of ordinary brains?

But Dr. Romanes finds an enormous difficulty still further in the way of the theory of materialism, viz.: that it necessarily embodies the theory of automatism, and is therefore called upon to explain why consciousness and thought have ever appeared on the scene at all. As it maintains that the physical changes in the brain produce thought, therefore thoughts and feelings cannot cause anything of their own in the brain, because they are but indices which show, in the mirror of the mind, certain changes which are proceeding in the matter of the brain, and are as inefficient in influencing those changes as the

shadow of a cloud is powerless to divert the movement of the cloud. But all this Dr. Romanes proceeds to show at length as opposed both to common-sense and to logic.

And, therefore, for these and for other considerations of a more metaphysical kind, which we have no time at present to quote, Dr. Romanes finally concludes that, at the bar of philosophy, materialism must be pronounced conspicuously inadequate to account for the facts.

But if matter cannot cause mind, or physical change cause mental changes, then how are brain and thought associated? In answer to this question Dr. Romanes first discusses what he calls the theory of spiritualism. By this term he means that view which conceives of the mind as having an independent existence or substance apart from the brain, and capable of acting upon it, and so using the brain as the mechanism of its thought, for he uses the term "spirit" as interchangeable with mind.

This theory of spiritualism he summarily rejects, because it seems to him to be merely

the theory of materialism inverted, and, therefore, that most of the arguments adduced in his analysis of materialism are just as available *mutatis mutandis* against spiritualism. For he claims that, in whatever measure it is inconceivable that neurosis should cause psychosis, in the same measure must it be inconceivable that psychosis should cause neurosis, seeing that the correlatives are in each case the same, and that it is as impossible to imagine mind affecting energy as it is to imagine energy affecting mind.

To imagine mind in any way directing the stream of physical causation is to suppose (according to him) mind becoming for a time, at least, a part of that stream, even though the contact should only be, as it were, at a point. This idea is pronounced, in a passage he cites from Prof. Clifford's "Essay on Body and Mind," as neither true nor untrue, but nonsense, and so Dr. Romanes says it is equally nonsense to speak of mind causing brain action or of brain action causing mind.

As this is a favorite way among this class of

writers of disposing of mind, we will meet it again very soon. It is of course obvious to everybody that, as such a dictum leaves us in mid-air as to what anything mental is, we must anxiously ask for the what next? If physical changes cannot cause mental changes, nor mental changes cause physical changes, what are mental changes anyway?

One answer to this question is a theory about mind which Romanes considers a highly important one, for, in the language of Clifford, "it is not merely a speculation, but is a result to which all the greater minds that have studied this question in the right way (namely, in Clifford's way) have gradually been approximating for a long time." This theory is that mental phenomena and physical phenomena, although apparently diverse, are really identical! The fact of there being so constant and precise a parallelism between neurosis and psychosis affords, according to Clifford, "a very strong presumption that we have here something which can be explained," that is, that as a relation of causality is found untenable either way, there remains

this other solution possible; viz., that there is no parallelism to be explained, but rather that the phenomena of mind and the phenomena of matter are ontologically one, being double only, as Lewes expresses it, in relation to our modes of apprehension. Just as the tremors of a violin string are phenomenally very different, according as our mode of apprehending them is with the eye or with the ear, so the tremors of a nerve are, both physical and mental, apparently dual, the event may be really singular, as an air on the violin is one with the vibrations of catgut.

But, continues Dr. Romanes, if the physical and the mental are thus supposed to be identical in the brain, the physical and the mental must be identical universally, for there is no reason to suppose the physics of the brain differs from physics in general. All physical motions, therefore, are likewise mental. We have not, indeed, to suppose that all physical motions think or feel—we have only to suppose that they present the raw material of mind, which has not as yet been wrought into feeling or thought, just

as the physics of crystalization has not proceeded so far in complexity or refinement as has the physics of life. In support of this view, namely, that we cannot draw anywhere a line between physics and psychics, Dr. Romanes quotes a passage from what he terms the most closely reasoned and profound of Prof. Clifford's philosophical writings, which reads :

"Mind stuff is the reality which we perceive as matter. A moving molecule of inorganic matter does not possess mind or consciousness, but it possesses a small piece of mind stuff. When the molecules are so combined together as to form the film on the under side of a jelly-fish, the elements of mind stuff which go along with them are so combined as to form the faint beginnings of sentience. When the molecules are so combined as to form the brain and nervous system of a vertebrate, the corresponding elements of mind stuff are so combined as to form some kind of consciousness. When matter takes the complex form of a living human brain, the corresponding mind stuff

takes the form of a human consciousness having intelligence and volition."

This view has this to recommend it to Dr. Romanes, that if there is only one substance, and the universe consists entirely of mind stuff, we have no longer anything to do with questions of causal priority between mind and matter, as they are both one and the same thing, and the requirements of equivalency are therefore satisfied in the world of mind and in the world of motion simultaneously. As he remarks, also, this view, though not identical with, yet approximates to, the doctrine of Hegel, that there can be no existence possible; i. e., of matter or of motion, except as standing in relation to mind.

With all his admiration for Clifford, however, Dr. Romanes finds the mind stuff theory inadequate to explain the fundamental antithesis between subject and object, and concludes that the only position in which we can find intellectual rest is that of which Hegelism seems to him "an adumbration"—namely, that the relation between mind and matter is inexplicable. All that we can

hope for, he says in closing, is that the progress of human knowledge may yet enable Philosophy to prove the world of things to be a sphere—"that all horizons are relative to our imperfect faculties, and that the shores of mind from which we started are proved by our return to be one and continuous with all the other lands of being."

Now, we ask in all seriousness, where has Dr. Romanes been taking us? We started with free enough strokes to leave for good, as we supposed, the fallacy of materialism, but alas! often before have we been fated, simultaneously with those ominous sounds "subject and object," to part with our last streak of blue sky, and so now the air thickens apace as we hear of pieces of mind stuff in the possession of inorganic molecules, then more mind stuff in the film under jelly-fish, *usque ad finem* in human thought and will, and then, *horresco referens*, the name of Hegel is sounded in our ears, until at last Dr. Romanes leaves us in the Great Inexplicable as our final intellectual rest!

If we still yearn, one dim hope vibrates as

a last echo, namely: That we may pull along until we find ourselves in the great Sphere of Things, where mind, to use his lucid expression, is continuous with all the other lands of being! If this last sentence means anything, it implies that Dr. Romanes still hankers after Clifford's and Hegel's view that subject and object are one. To find oneness in things makes a man feel philosophical, but common-sense stubbornly says that by the time a man by thinking has come to see that interesting object, the moon, to be two distinct things; viz., the object moon which is seen, and himself also, the subject who sees it—well, he is intellectually drunk!

Our next and last authority which we have time to quote from is Prof. Huxley, who enables us by his customary terseness and clearness of expression to be much more brief in examining what he has to say on materialism. In an article in the *Fortnightly Review*, Volume XI., p. 793, he says: "I understand the main tenet of materialism to be that there is nothing in the universe but matter and force, and that all the phenomena of

nature are explicable by deduction from the properties assignable to these two primitive factors. This, I apprehend, is the fundamental article of the faith materialistic, and whosoever does not hold it is condemned by the more zealous of the persuasion (as I have some reason to know) to the inferno appointed for fools and hypocrites.

"But all this I heartily disbelieve. In the first place it seems to me pretty plain that there is a third thing in the universe, to wit, consciousness, which, in the hardness of my heart or head, I cannot see to be matter or force, or any conceivable modification of either, however intimately the manifestation of the phenomena of consciousness may be connected with the phenomena known as matter or force." Prof. Huxley, indeed, finds it difficult to conceive much of anything about either matter or force apart from their sensible properties, for he says: "I must make a confession, even if it be humiliating. I have never been able to form the slightest conception of those 'forces' which the materialists talk about as if they had samples of

them many years in bottle. They tell me that matter consists of atoms, which are separated by mere space devoid of contents, and that through this void radiate the attractive and repulsive forces whereby the atoms affect one another. If anybody can clearly conceive the nature of these things, which not only exist in nothingness, but pull and push there with great vigor, I envy him the possession of an intellect of larger grasp not only than mine, but than that of Leibnitz or of Newton.

"Let it not be supposed that I am casting a doubt upon the propriety of the employment of the terms 'atom' and 'force' as they stand among the working hypotheses of physical science. As formulæ which can be applied with perfect precision and great convenience in the interpretation of nature, their value is incalculable, but as real entities, having an objective existence, an indivisible particle, which nevertheless occupies space, is surely inconceivable, and with respect to the operation of that atom, where it is not, by the aid of a force resident in nothingness, I

am as little able to imagine it as I fancy anyone else is."

What we would note here is that Prof. Huxley already finds himself among things inconceivable while yet dealing with questions about the material world. It is the element of inconceivableness which leads him to doubt. Hence, although he abjures materialism because it is plain to him that there is a third thing in the universe besides matter and force, to wit, consciousness, and which he cannot see to be matter or force or any conceivable modification of either, he rejects on the other hand the identification of that third thing, consciousness, with spirit, on the ground of the inconceivableness of spirit also. For he says: "As to spiritualism, it lands me in even greater difficulties when I want to get change for its notes of hand in the solid coin of reality. For the assumed substantial entity—spirit—which is supposed to underlie the phenomena of consciousness, as matter underlies those of physical nature, leaves not even a geometrical ghost when these phenomena are abstracted. And even if we sup-

pose the existence of such an entity apart from qualities—that is to say, a bare existence for mind—how does anybody know that it differs from that other entity apart from qualities, which is the supposed substratum of matter? Spiritualism is, after all," he continues, "little better than materialism turned upside down. And if I try to think of the spirit which a man by this hypothesis carries about under his hat as something devoid of relation to space and as something indivisible even in thought, while it is, at the same time, supposed to be in that place, and to be possessed of half a dozen faculties, I confess I get quite lost." So, to use his words, he will have nothing to do with the effete mythology of spiritualism.

Turning, however, to what consciousness is, he says that he has been charged with materialism because he had said that consciousness is a function of the brain. In reply he says that he is not aware that there is anyone who doubts that in the proper physiological sense of the word "function," consciousness in certain forms, at any rate, is a cerebral function.

In physiology, he maintains, "we call function that effect, or series of effects, which results from the activity of an organ. Thus it is the function of a muscle to give rise to motion, and the muscle gives rise to motion when the nerve which supplies it is stimulated. If one of the nerve-bundles in a man's arm is laid bare and a stimulus is applied to certain of the nervous filaments the result will be the production of motion in that arm. If others are stimulated the result will be that state of consciousness called pain. Now if I trace these last nerve filaments I find them to be ultimately connected with part of the substance of the brain just as the others turn out to be connected with muscular substance. If the production of motion in the one case is properly said to be the function of the muscular substance, why is a production of a state of consciousness in the other case not to be called a function of the cerebral substance? Once upon a time, it is true, it was supposed that a certain 'animal spirit' resided in muscle and was the real active agent. But we have done with that wholly superfluous fiction so far as

the muscular organs are concerned. Why are we to retain a corresponding fiction for the nervous organs ?"

Prof. Huxley then follows this expulsion of spirit from any relation to consciousness, which according to him stands instead in a functional relation to brain matter, by re-affirming more emphatically than ever an opinion formerly expressed by him, that the progress of science means the extension of the province of what we call matter and force, and the concomitant gradual banishment from all regions of human thought of what we call spirit and spontaneity. This dictum; viz., that matter and force are destined to crowd out spirit and spontaneity from the world, he holds does not make him a materialist by any means, for he finds it consistent with the most thorough-going idealism. For spontaneity means to him uncaused action, and he thinks that he shares a disbelief in such spontaneity with Spinoza and Leibnitz among philosophers, and with Augustine, Thomas Aquinas and Calvin among theologians. We might also add, that in addition

to these illustrious names, we do not know of anybody else who believes in uncaused action.

We confess that by all this we are becoming somewhat bewildered by Huxley just as we were before by Romanes. We seemed definitely to leave materialism behind when Prof. Huxley told us that there is certainly a third something in the universe besides matter and force; viz., consciousness, and which he could not conceive of as a modification of either, but as a something distinct from them both. Now, with but a few paragraphs intervening, he tells us that science is wholly to substitute matter and force for everything called spirit and spontaneity. We, therefore, turn back to find what he pronounces that third something, viz., consciousness, to be, and all that we can get out of his words is that consciousness in certain forms at any rate, is a function of the brain. Then, finally, when the really crucial question arises whether this consciousness can exist separate from the material brain, and, therefore, may not die with the brain when it dies, his language is as follows :

"As physical science states this problem it seems to stand thus: Is there any means of knowing whether the series of states of consciousness, which has been casually associated for threescore years and ten with the arrangement and movements of innumerable millions of successively different material molecules, can be continued, in like association, with some substance which has not the properties of matter and force? As Kant said on a like occasion, if anybody can answer that question, he is just the man I want to see. If he says that consciousness cannot exist except in relation of cause and effect with certain organic molecules, I must ask how he knows that, and if he says it can, I must put the same question. And I am afraid that, like jesting Pilate, I shall not think it worth while, (having but little time before me,) to wait for an answer."

Thus, as Dr. Romanes left us in the midst of the great Inexplicable, so Prof. Huxley now gayly leaves us in the mid-point of the great Unknowable. If you look this way, he jestingly exclaims, How do you know that?

And if you look that way, again, How do you know that? Good-bye, for time is up!

We admit our experiencing some soreness of spirit at this situation for this reason; namely, that we have long been conscious of sundry frequent deflections of our course produced by a jerky and irregular use by these scientific guides of certain terms or words. Occasionally these words tend this way and then that, with a consequent unwarrantable change in direction. It is vexatious to have to show all this, for it obliges us to lose a great deal of time in retracing our course, but we cannot help it, as otherwise we might as well give up our attempt to reach some landing-place altogether.

Thus, all through this reasoning, we have a great use of the term "Inconceivable," by way of an answer or refutation. When this word is pronounced, it is as the death-sentence of every opposing hypothesis or argument. Two other words are also often employed by this class of reasoners, sometimes as synonymous or interchangeable with inconceivable, or at least of equal rank with it in

executive authority to enforce a quietus; namely, the words "unthinkable" and "unknowable." But let us examine, for a moment, the title to such high jurisdiction of each one of these words. This word "inconceivable" has at least two very different meanings (and therefore very different authority in our present discussion) according to its relation to two quite distinct mental processes with which it is often connected. Thus, a fact may be both conceivable and equally inconceivable. Take for illustration, the idea of infinite space. According to our logical faculty, we cannot conceive of space being otherwise than infinite. By that mental process we cannot conceive of any distance so great that we must necessarily stop there, because there can be no beyond to that. But try to picture infinity to yourself and you find it utterly unimaginable. The imagination indeed is a faculty which makes pictures, but the materials of its pictures are always earthly and it quickly fails, when asked even by logic, to follow it away from this earth. The astronomer tries in vain to help it by making it take passage on a rapid ex-

press train to the nearest fixed star, for his time-table of some twenty-five millions of years extinguishes the poor imagination as effectually as his previous statement of the mileage did. And yet we find these writers constantly using this word inconceivable, when they really mean unimaginable. We have just found Prof. Huxley doing so when he says that he has never been able to form the slightest conception of those "forces" or of those "atoms," which are separated by mere space devoid of contents, through which they radiate their attractive and repulsive "forces." What he really means is that he cannot imagine atoms. But the majestic science of chemistry has conceived a good deal about atoms, by logical inference, and will hold on to its inferences whether Huxley or anybody else can conceive them or not. How easy is it also to conceive, in any sense, that wonderful Ether which the physical philosophers now talk so much about?

The term "unthinkable" may also be used in its own proper sense, or it may mean simply

"unintelligible." A statement may be truly pronounced unthinkable if it involves a flat contradiction to what is thinkable, as, for example, that a given line may be, and also not be, perpendicular to the same plane. But another statement may be beyond the reach of any faculty of the mind, whether logical or otherwise, simply because, for any thinking about it, the materials out of which ideas are evolved are wholly wanting. Thus, we have some of our own species who have never had more than four senses. A very intelligent man, for example, upon whose memory not a trace of the sensation of light on the retina was possible, once told me that he had seen a great cannon and the projectile which was used in it. He described both these objects very well; in fact, better, naturally, than I would, for he particularly noticed the proportionate weight and shape of the projectile and the smoothness of the bore of the cannon with a better educated sense of touch than mine. Now, if such an intelligent man as he was should have a part of Dr. Huggins's presidential address before

the last meeting of the British Association of Science read to him, which told him that Dr. Huggins could prove by his spectroscope that the star β Aurigæ is a double star, and that although it is not probable that a telescope will ever be made which will show this seemingly single star to be actually two, yet that his spectroscope tells him it is two, and that each of the pair is a much larger sun than our sun, and that they are distant from each other only 8,000,000 miles, or less than one-twelfth of the distance of the earth from our sun, and moreover, that his spectroscope also tells him just how heavy they are and how rapidly they revolve round each other, down to the distance, per second, of one tenth of an English mile; that is, the distance between Forty-seventh and Fiftieth streets; and lastly, that they contain hydrogen, iron, sodium and other metals. What would this blindman first try to do? He would ask for this wondrous spectroscope and feel its prism all over, and then he tries whether it has sound, taste or smell, how heavy and how hard it is, and then he leaves it, saying: "I

cannot conceive how this angular thing can possibly tell you anything about two worlds which you call fixed stars, and which you say are vastly more distant than the nearest of those stars, and which nearest would take the Chicago Limited over twenty-five million of years to reach. You say that the best of telescopes show any one of these stars only as small bright points like pin points. The only points I know of are those which prick; are they like them? Your spectroscope reminds me most of the glass pendants in my parlor chandelier, and a telescope seems to me most like a great cannon, which, however, is never loaded, and as to the spectrum image on its screen, which you speak of, let me feel it, to find whether I can tell what those lines in the red band and in the green are like which give you so much information." Indeed, what would be the blindman's mental attitude to any such statements? In the first place he would hunt in vain for any adequate materials in his mental store which would afford him the slightest data for a correct understanding of the spectroscopic analysis. To

him such statements would be simply unintelligible from beginning to end. But would he therefore pronounce them to be nonsense, (as Romanes says that to say mind acts on matter is nonsense,) that is, really unthinkable? All which such a rational mind would say is that the "how" of the spectroscopic analysis is beyond his powers of imagination and his powers of logical inference. Likewise all that a rational mind need say about the "how" of the action of mind upon matter, or conversely of matter upon mind, is that said "how" is now simply unintelligible to us, but that where nonsense is actually present is in the mouth of him who denies that such reciprocal interaction exists.

It is, however, with the term "unknowable" that these thinkers clear the court-room of all protestants the most frequently and summarily. If they used this term in its legitimate sense they might rest assured that there would be small occasion for them to have resort to its process of ejectment, for the simple reason that neither they nor anyone else would often bring their questions

for adjudication to the bar, either of science or of philosophy. The only thing we ever really know is some fact of undoubted personal experience. About all other facts we do not know, but, instead, we infer, which essentially is a very different thing from real knowing, however great our sense of the certainty of our inferences be. Therefore, only he deserves to have the straight-jacket of the "knowable" put upon him who talks without having any facts of experience to begin with. If he had any such facts whatever he could legitimately claim the right to go as far as they went, and stop there, with inferences for the rest of the way, just because that is the scientific way of doing things. The ratio between his facts and his conclusions might be—facts 10, plus inferences 90, equal conclusion 100. But his process is purely legitimate, nevertheless, as the whole world of science will testify. For there is scarcely a branch of science in which this process is not about the only process possible. Because in each the facts of real knowledge only lead part way to the conclusion, with the remain-

ing proportion of inferences of very varying amount in each. In chemistry, for example, the whole science rests on inferences, and probably always will. What, also, is geology based upon but inference?

But in the whole sisterhood of the sciences it is biology which depends most on inference for her very life. Strip biology of everything except the concrete knowable, and do away with all conclusions by inference, and it would be hard to imagine what a congress of biologists would find to talk about. If they began with mentioning living protoplasm—what is life?—how much do they know? that's the word now *know*, that said protoplasm is living or not living, or how much living, or when it began to live, and what it does when it stops living?

As the leading author in the English language on physiology, Prof. Michael Foster says, (p. 36, fifth edit.): "Our knowledge of the nature of Protoplasm cannot at present, and possibly never can, be recognized by the microscope, and therefore must be based on inferences;" and again, (p. 34): "The differ-

ences between a dead human body and a living one are still, to a large extent, estimated by drawing inferences rather than actually observed." Alas for Romanes, Huxley and all their brethren, if the straight-jacket of the "knowable" is to be put upon him among them who begins inferring instead of knowing! If they of all men were not allowed to infer, but only to know, they would be of all men the most miserable, for what would then become of Natural Selection, Evolution and the rest of their great array of inferences, which, even as theories, are scarcely yet out of the embryonic stage of development, but are still showing rapid changes of form in their soft parts, first of hypertrophy and then of atrophy. There is, in fact, much of mere dialectic artifice for begging the whole question at issue in their frequent recourse to the sounding word "unknowable" on the part of writers of this school, who show the greatest readiness to emancipate themselves from the really knowable whenever it suits their convenience. The only fair procedure in any discussion on the facts of Mind, of Life or of

Death, is to recognize the right of every one, whatever his tenets be, to infer, and to judge him accordingly. To ask anyone, when considering such questions, how he knows this or how he knows that, is much like asking a ship captain how clearly he sees the coast he is sailing to and refusing to trust him till he does see it.

We have dwelt thus long on the meaning of certain terms, because, without such a preliminary examination of their applicability we would have to be silenced in a discussion of the most important question in the world, by some of the loosest reasoning which has ever been occasioned by it. To lose no more time, therefore, we will finally consider but one term further, and that is the meaning of the term "function," for, as we have seen Prof. Huxley use this word, the whole question turns upon it. Consciousness, in certain forms, at any rate, he states to be a function of brain matter. We take it, therefore, that he will not object to the identification of consciousness, in certain aspects of it at any rate, with mind. Prof. Huxley, as we have

seen, defines "function" as "that effect, or series of effects, which results from the activity of an organ." To which definition I will only add that we mean by "function" the specific work of an organ or tissue for which work it has been specifically constructed; hence there is no function, vital or non-vital, without corresponding structure. A lamp is a construction for a function; viz., that of giving light. So is a steam-engine a structure for a function. Derange the structure and you will correspondingly derange the function. Let the wick be cut in the lamp or otherwise damage its mechanism and its light-giving function will be correspondingly disordered. Every function of the living body exactly corresponds to these facts in mechanism. Each pysiological function depends upon its corresponding specific bodily mechanism, and we do not see how the nervous mechanism can be an exception to this rule any more than the muscular or the glandular mechanisms of the body are.

But here comes the important point, and it is this: Mechanism, though an essential, yet

is not the only essential part of function in any example whatever, living or not living. You may have the mechanism of a lamp perfect throughout, but the function of light-giving imperfect, deranged or utterly impossible, because the oil is bad, or mixed with water, or because there is no oil in the wick, but only water. In every mechanism, therefore, the mechanism is nothing by itself. Therefore, is the nervous mechanism anything by itself? If not, what is needed plus mechanism in the nervous system for nervous function? If we look to the nearest apparent quarter for that important plus quantity, and were guided by the facts connected with the other bodily functions, we would have to answer, Supply good blood to the nervous mechanism, and then it will functionate accordingly. The blood thereof is the life thereof, quite as much in the nervous system as in the muscular system. If you doubt it, mix a little of that functional poison, opium, with the blood and you will see. You will have then the completest kind of functional nervous manifestations; that is, opium think-

ing, without the best microscope being able to show afterward the slightest structural change, in any part whatever, of the nervous mechanism.

Therefore we can proceed now at a rapid pace. Healthy blood is transformed food stuff, and brain function; that is, feelings, thoughts, purposes and what not, bear the same genetic relation to our meat and potatoes as Stephenson's famous express train to its ultimate source of energy, when he remarked, as it thundered past: "There goes the light of the sun!" Mind stuff, therefore, resides in our meat and potatoes, as truly as the light of the sun resides in the opaque coal of the steam-engine, and behold in it is the plus quanity requisite for the nervous mechanism to functionate; that is, to manifest thought. Is that what Prof. Huxley means when he says that consciousness is a function of nervous matter?

This is no small question. No one would care long to debate about it if it were only a question of natural history. It is rather a question which overshadows all others

in practical importance, for it comes to each man as no other question does when reduced to its naked statement; thus, am I a Function or a Person? If I am a function, then I am only a result of a nervous mechanism energized by blood. Derange my nervous mechanism and I will be a correspondingly deranged personality. Derange the functional element in my blood and I will be a correspondingly modified personality. Derange either of these necessary constituents of my personality to what is termed the fatal degree, and then I end altogether! For, is not the idea of a spirit or mind independent of both nervous tissue and blood, a fiction, a ghost, which a man carries under his hat, inconceivable because it hath no geometrical figure?

We have the issue now joined. Therefore we say here plainly that whoever claims that mind is a function of nervous tissue in any proper physiological sense, is a pure materialist, whether he likes the name or not, for logically the statement is that, as muscle structure and blood are the only factors

known to the physiologist, for the genesis of muscular function, when its proper stimulus is applied, so may the same be said of nervous structure and blood, as the only factors in the genesis of mind. The answer to this materialistic doctrine is that a very different statement of the case can be made thus: Instead of consciousness or thought being a function of nervous tissue, the perception of a sensation through nervous tissue is a function of consciousness—that is to say, consciousness is independent of nervous tissue, and uses nervous tissue to perceive with. Therefore, though we may say that at present, the conditions of mental manifestations require the conditions requisite for nervous function, this is only saying that the conditions of nervous function are the occasion, but not the cause, of mental working, just as a microscope is the needful condition for seeing objects which without it would be totally invisible. But to speak of consciousness or thought as a function of nervous matter is to bring thought into the same category with bodily and material functions in general, and therefore to pro-

nounce it a product of some form of energy acting through its proper mechanism, when facts may show that this can no more be maintained about thought than one can maintain that the microscope itself sees, instead of being seen through, though without the microscope nothing that is seen through it would be seen at all, or if the microscope's lenses are out of order, so will everything seen through it be seen badly. That the microscope does not see, however necessary it be for seeing, is manifest, because nothing in the universe out of which microscopes can be made can have the faintest connection with a power of consciousness. How perfectly *sui generis* any operation of consciousness is, and how specifically different from any property or consequence of anything material or unconscious, we have seen stated in the strongest terms by Romanes, Allman and Tyndall, and yet if consciousness is a function of cerebral matter it is no different from the light given off from the oil in a lamp, and is the purely material result of purely material conditions. Are there any reasons, therefore, for supposing

that, besides blood-derived energy, there is anything else acting in or on nervous matter which is itself neither the one nor the other, nor both together of these two? Something which really corresponds to Huxley's third thing in the universe, which is neither matter nor force, nor any conceivable modification of either, and which if Huxley had only held on to, we would have had no dispute with him? If there be this something else, what is it?

This question brings us to those confines of mental territory where only illustrative analogies can be used. One disputant will say that given a nervous mechanism and its needful source of function, and you have a suggestion of a musical instrument, a violin, for example. A violin's strings are so placed over a properly constructed cavity for air to resound in, and the due tension of each string is so provided for by its proper mechanism that all you need now is a musician, who will take it up and play. Its function is to give out music. Damage any part of the mechanism, as by loosening its strings, and no musi-

cian can make it give out music, but, at best, only noise. Analyze the product, namely, sound, and that is no part of the mechanism, but of the air in and around the box. But, to produce music, you must have something quite distinct from either the violin or the air, namely, the musician. Without him the violin would give forth no music, however constructed it be for music, or however well you supplied it with air.

But, for exact thought, we must always be on our guard about illustrations. Illustrations are the favorite handmaids of error, because they can so naturally work all the mischiefs of half truths, in the fact that they emphasize only the applicable parts of any analogy, and thus serve to hide all the defective parts. For another disputant may say that not the violin, which needs a musician to make it give out music, is the proper illustration in point, but a mechanism which does give out music without any musician whatever, namely, an Eolian harp. According as you arrange the strings, at different distances or angles from each other, and at different

lengths, and then place them so that a current of air will flow through them, you will have music accordingly, varied with the strength, or velocity of the current. The air is part of a vast ocean called the atmosphere, and while each harp has its peculiarities according to its size, number of wires, position, etc., its function source has no peculiarity, but is one and the same in all. So a man may be a specially constructed mechanism, whose individual peculiarities are all due to the arrangement of his fibres. Some lives give forth long, rich, harmonious notes throughout; others, from unhappy arrangements of their fibres, give forth little else but prolonged discords, and others a strange mixture of both; but all these individual or so-called personal characteristics are matters of fibre arrangement, as this is played upon by the great ocean of psychic force (if you so please to call it) in the universe. Put in this way, we turn for our answer to what we can infer from an inspection of the physical mechanism itself of thought, namely, the Nervous System. Does an inspection of its

structure and mode of working give us grounds for inferring that, like the violin, it needs something quite independent of itself to cause it to give forth its wondrous manifestations, or is it like the Eolian harp, which contains within itself, and the accident of its location, every condition necessary for its specific operations?

What, therefore, is a nervous system? The term itself implies that it is a composite structure and so, in all the higher animals, we must describe their nervous systems as congeries of an immense number of nervous systems, each of which can be regarded as originally separate and independent, and yet each equally illustrating the same fundamental modes or laws of nervous operations. It is hence necessary to go down to the lowest forms of life, which show the presence of a nervous system in its simplest state, to determine what primary nervous action is, because in animals higher in the scale than they, with a number of such systems associated, their mutual interaction causes the operation to be proportionately more complex.

Now, such a primary nervous system is found to be composed of three parts.

The first is a fine streak of nervous matter, proceeding inward from the surface until it ends in the second element, which is a cell, or small collection of nervous cells hidden within, and called the nerve centre, because from it proceeds the third and final part of the system, namely, a second nerve filament, quite like the first in appearance, but very different from it in function. For the function of the first filament is to transmit an impression made upon it at the surface to the nerve centre. The second filament, on the other hand, originates in the nerve centre, and therefore transmits not an impression but an impulse from the nerve centre outward. It ends most frequently in a small plate which is applied to a muscular fibre, and its impulse is manifested by its causing the muscular fibre to move, or to contract. The first nerve is, therefore, frequently called a sensory nerve, because it transmits something like a sensation to the nerve centre, and the second a motor nerve, because it causes muscular movement. The

better terms, however, because more general, are afferent instead of sensory for the first nerve, because it indicates transmission to, and efferent for the second nerve, because it transmits from, or out of, the centre. Because many afferent nerves do not transmit sensations, properly speaking, and many efferent nerves do not cause motion. Hence we have our primary nervous system consist of one nerve afferent and one nerve efferent and one centre.

Now, as we have some insight into the functions of the two nerves, what is the function of the nerve centre? As Dr. Foster says, the advent of an impression by the afferent nerve is a busy time for the centre, during which many processes, of which at present we have very little exact knowledge, are being carried on in it, but which end in something very like an explosion, which makes its exit by the efferent nerve. The nerve centre therefore does not merely turn the impression of the afferent nerve on to the efferent nerve, but it takes some time to deliberate on the subject what it will do. In fact, it is only habit which will

make a nerve centre work fast, a very important fact, as we shall soon see. Now, this arrangement is not one of a transitory kind, but obtains throughout all subsequent developments. Let thousands of such nervous systems be joined together to make up, by their unison, the one grand system of man, yet from the lowest nerve centre in man up to the highest in his brain there is no reason to doubt that the mode of operation will still be the same in each. It is the law in nervous function that whatever new operations are developed or added no old or previous ones are superseded.

The next step in development is in the direction of multiplication of nerve centres, each with their indispensable afferent and efferent parts. But a new element now makes its appearance, namely, that, though their respective afferent and efferent nerves are never united, their nerve centres are so by fibres passing from centre to centre. These fibres are termed communicating fibres, and their business is to make the centres work together. This they do in two ways. One

is that the afferent nerve of one centre will not only start up changes in its own centre, but its impression may run along the communicating nerves to the other centres and, so to speak, touch them off too, causing them to all explode together, or one after the other, in a definite order. Thus, a single afferent impression, starting from the sensory fifth nerve in the nose, will start the nerve centres of some fifty-five pairs of muscles, each in its orderly succession, to execute a sneeze.

But these communicating fibres act also in another and apparently reverse way—namely, the other centres may, through them, not only refuse to allow the original afferent impression to go further, but may send back an order to the first centre that it should react to its afferent impression either not at all, or else only as they see fit, so to speak, that it should react. In other words, nerve centres control one another.

This mutual restraining or controlling influence of nerve centres upon each other by means of their communicating fibres introduces us to another and third grand element

in nervous operations to which the term Inhibition is given. We find as a fact that as we rise in the animal scale and new parts are added to the nervous apparatus, with new and higher functions, that they assume the control of their lower predecessors by this property of inhibition ; and so important becomes this element, as the system becomes more complex, that special nerves for inhibiting or controlling are often provided for the working of important parts. Thus the heart is stirred to activity by its appropriate efferent nerves ; but, at the same time, a very important efferent nerve also goes to the heart to make it beat slowly. Without inhibition, indeed, there could be no co-operation between nerve centres possible. This, too, is a universal law in the nervous system, and shows itself splendidly in the highest of nervous manifestations, that of human thought itself. What is a strong, well-disciplined mind but one in which inhibition, or the power of restraint, is greatly developed, for it is the very source of good judgment.

After a certain number of nerve centres

have become associated, according to the scale of the animal's development, we find that the mutual co-operation of the centres begins to be plainly more frequent in certain directions than in others; that is, that it seems easier for the centres to act together, to execute certain movements, than to execute other movements. When we come to examine why this is so, it becomes evident that it is because of the more frequent repetition of certain afferent impressions than of other afferent impressions. Repeat one afferent impression a hundred times and another afferent impression only once, and the movements consequent on the first are plainly much more readily caused than those consequent on the unusual impression. Therefore we have come now upon another grand element in nervous operations, whose importance cannot be over-estimated, and that is Habit. The whole nervous system, indeed, is organized by habit. However complex, for example, be the movements executed by muscles in order to produce a given effect, such as movement of the eye-balls, some muscles con-

tracting strongly, others most gently, others relaxing just enough to allow their opponents to contract just so much and no more—all these perfectly associated movements are nevertheless explicable only as the slowly acquired habits of the centres which supply those muscles with their motor nerves. But here comes the important question, how did these centres come to acquire these habits? The answer is from a thousand thousand times repeated afferent impressions, such as those of the afferent optic, or sense of sight nerve, in habituating the efferent or motor nerves of the eye muscles to act together.

Physiologists, therefore, when they speak of nerve centres being organized to perform such and such functions, mean not that the nerve centres have been created so from the beginning, but that habit has so organized them.

But the important principle to bear in mind just here is that it is the afferent segment of the nervous system, or that which is acted upon by impressions from the outside world, which is the ultimate source of habit, this

great organizer and builder-up of the nervous system, and not the nerve centre itself, nor the efferent segment. This fact is one which materialists enjoy dilating upon, as indicating that mentally, as well as physically, we are created by our outside world, or, as it is termed, by our environment.

We are soon to see that its completest illustration is to be found in the genesis of one of the loftiest and most intellectual and most exclusively human of the powers of the human mind. But we are much mistaken if habit, when it does then tell its whole story, will not make the materialists wish that they had not called it on the witness-stand.

These remarks find a complete illustration in the structure and functions of the Spinal Cord in all vertebrates. The spinal cord, which is the original nervous system in every vertebrate, as it is the first to appear in its embryonic development, consists of a great number of nerve centres, one above the other, all receiving their afferent and giving off their efferent nerves on each side, and as constantly joined together by tracks of communicating

fibres, until, finally, the whole muscular system of the body is found to be under its exclusive control.

As we remarked before, no primary law or function in the nervous system is ever superseded by any later developments, and so, however great the additions be of brain centres or functions afterward, yet the spinal nerve centres retain all their original prerogatives, quite as much in man as in any of the rest. If you wish to show the cunning of your right hand in any work of skill, or the fluency of your speech with your tongue, your designing and talking brain has to ask the spinal nerve centres for the muscles of the hand and for the muscles of the tongue, to direct those muscles to do the work for it.

Even the motor nerves of the muscles for moving the eyes, or for any expression of the face, are to be found running under the brain to their virtually spinal roots at the base of the skull. It is, therefore, when we sever the spinal cord from all connection with the brain (which we can do by decapitation in some animals), and yet have the headless body re-

tain its vitality long enough to enable us to experiment with it, that we learn how complete the organization of this spinal system is.

Indeed it is startling to note then how perfectly the operations of the body are carried on by a mechanism which certainly has no intelligence or purpose direction in its actions, and which yet will work just as if a guiding brain was directing it. It is then that we discover what a thorough organizer habit is. Thus, if a drop of an irritating acid be placed on the right flank of a headless frog he soon raises his right leg and gravely scratches away at it as if he felt the itching acutely. Now, hold his right leg so that he cannot scratch with it, and he seems much disturbed thereat, until finally he appears to conclude to bring up his left leg and cross it over to wipe the offending acid off. So with a decapitated snake; a stick passed along its body will cause it to coil around it, just as when it had its head on, the only difference being that it will now do the same to its quick destruction around a red-hot poker.

In structure the spinal cord has its centres,

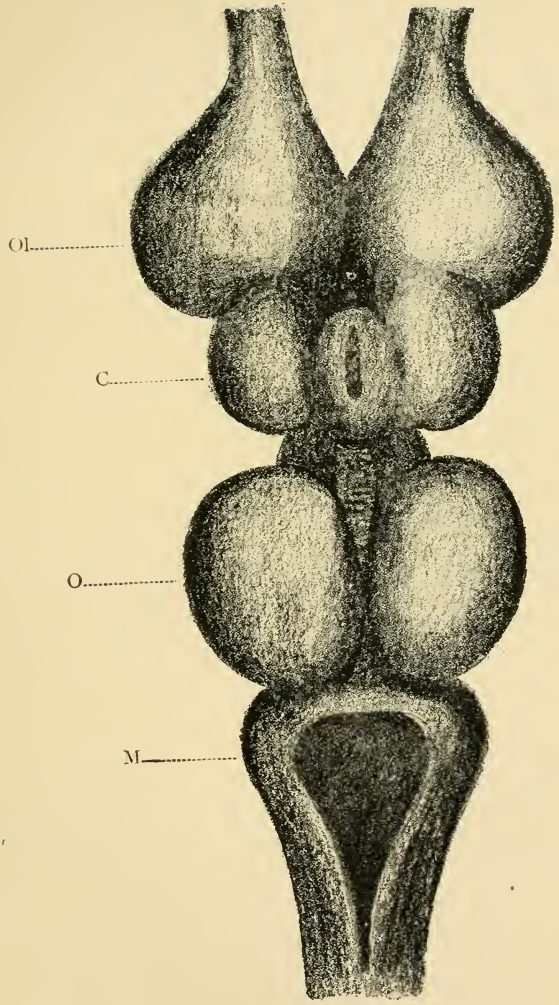
or ganglia, as they are termed, located within, and like all ganglionic matter, they are of a gray color. There is a special arrangement, however, of its cells, according as they subserve an afferent or efferent function, the afferent cells of a more or less rounded shape being grouped more toward the posterior segment of the cord where the afferent nerves enter, and the cells with efferent functions, usually larger and of a stellate shape, being grouped toward the anterior segment, whence the motor nerves emerge.

The rest and greater part of the bulk of the cord is made up of the white matter, which consists of tracts of nerve fibres, so colored by a sort of insulating material, which surrounds each nerve fibre in its course to or from a ganglion. At the top of the cord as it enters the skull is developed the final supreme centre of the entire system, the medulla oblongata—that fit and most responsible ruler of the whole wonderful and beautifully regulated spinal mechanism—that centre in which a small injury would threaten life much more than it would in the brain, as it

may cause instant death, for the medulla holds the reins of the pulse and the breath in its hands, while it acts, at the same time, as the intermediary between the various regions of the brain above and those of the spinal cord below

So far, however, it must be said that we have nothing but mechanism pure and simple. For, when we examine the element of irritability which is the initial phenomenon at the origin of an afferent nerve on the surface, and note its travels, with the subsequent efferent effect on the protoplasm of a muscle cell, we see but little difference in it from the familiar effect of touching a sensitive plant with its resultant shrinking of the leaves. The great difference lies in the incessant repetition of such afferent stimuli setting up, after awhile, in the nervous structure, a uniform kind of reaction.

But, after we pass the medulla oblongata, we find ourselves proceeding along large tracks of nerve fibres, which soon present us with a series of considerable swellings along their course, which are found to be altogether



BRAIN OF A LAMPREY.

new and differently constructed ganglia from those of the spinal cord. These new ganglia prove to be chiefly most portentous developments of the afferent system, for they are no less than the centres of the special senses of sight, smell and hearing, larger or smaller, according to the needs of the animal for each sense respectively.

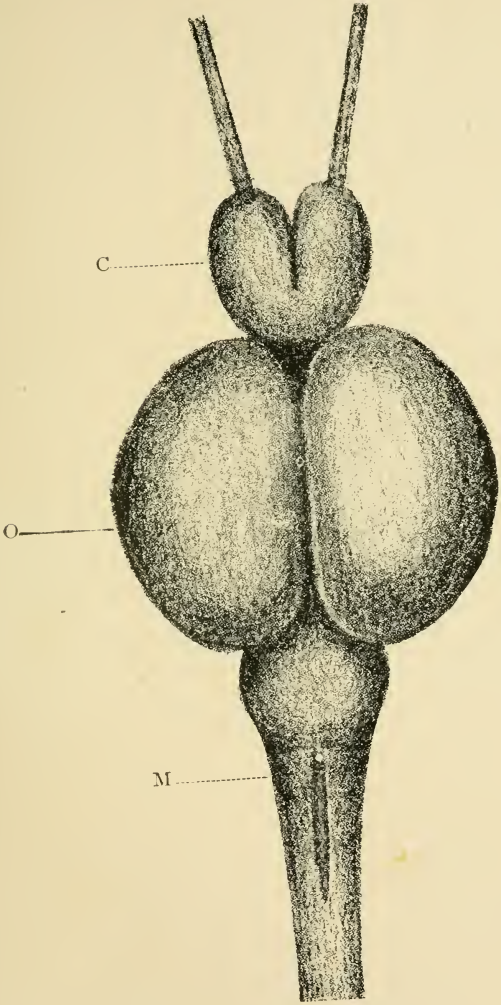
Along with these, in the lower vertebrata, appear two swellings, which are relatively wonderfully small in many of these animals, considering their great import, but which are no less than the beginnings of the cerebral hemispheres, or what we call in ourselves the brain. In this figure, No. 1, we have the sensory ganglia and the brain of a lamprey, a small fish often mistaken for an eel from his form, and which the cultured Romans used to prize so much that we read that the accomplished literary critic, Asinus Pollio, invited Augustus Cæsar and Mæcenas to dine on them to judge what a nice flavor they had after being fed on cut-up slaves.

You see those rounded masses, Ol, represent his olfactory lobes, for his habits require

him to be good at smelling, though it should be remarked the Romans fed him on white slaves. Then these two large swellings below are his optic lobes, while those two insignificant spheres between, marked C, are his cerebral lobes or brains, or all that he has to cogitate with. Fig. 2 is the sensory and intellectual apparatus of a carp. He does not smell at all, so he has no olfactory lobes, but you see how large his optic lobes are compared with his brain or mental equipment.

Here also is that old friend of the physiologist, the poor frog, experiments on whom have taught us more about ourselves than half the metaphysicians of history, and yet his mechanism for thinking, though larger than that of fishes, is scarcely larger than his optic lobes. M in each of these figures represents the medulla.

But a great subject arises here at once. Have we not here met with that great mysterious something which we call Consciousness? Of course we have. I cannot perceive how a special sense, such as sight or hearing, can imply anything else. The difficulty has



BRAIN OF A CARP.

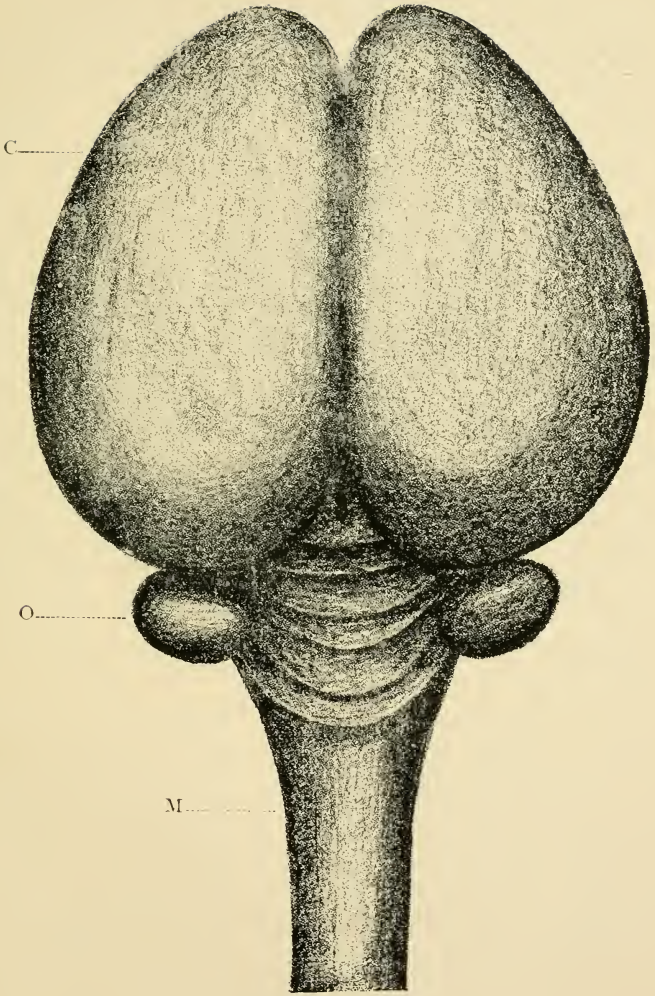
been with many reasoners that they cannot sufficiently divest themselves of the associations connected with the term consciousness, when applied to human beings, to judge correctly of its actual presence in these lower vertebrate relatives of ours who, nevertheless, must have some form of consciousness, however rudimentary their cerebral lobes are, for otherwise they could not see or hear.

But when we come to the results of experiments, especially very recent ones which Prof. Ferrier in the Croonian lectures for 1890 describes, we can have no question on the subject. When in osseous fishes, such as the carp, the ganglia, which correspond to the cerebral hemispheres, are removed there is little, if anything, to distinguish them from perfectly normal animals. They maintain their natural attitude, and use their tails and fins in swimming with the same vigor and precision as before. As Vulpian and Steiner have shown, they not only see, but are able to find their food. If worms are thrown into the water in which they are swimming they immediately pounce upon them. If a piece

of string similar in size to a worm be thrown in they are able to detect the difference, and they drop it after having seized it.

They even, to some extent, distinguish colors, for when one red and some white wafers are thrown into the water, the fish, almost invariably, selects the red in preference to the white. So also the frog. If care be taken to keep him alive, after the removal of his cerebral lobes, until he gets quite well from the injury, the recent experiments of Schrader show that brainless frogs will behave just like full-brained frogs under like circumstances. They crawled under stones or buried themselves in the earth at the beginning of winter, and after the period of hibernation was over they came out and diligently caught the flies which were buzzing about in the vessels in which they were kept.

As to birds, which are much higher in the scale of development than the amphibia, which the size of the cerebral lobes here in the pigeon well shows, yet, even in them, removal of their lobes did not in Schrader's and Von Recklinghausen's experiments result



BRAIN OF A PIGEON.

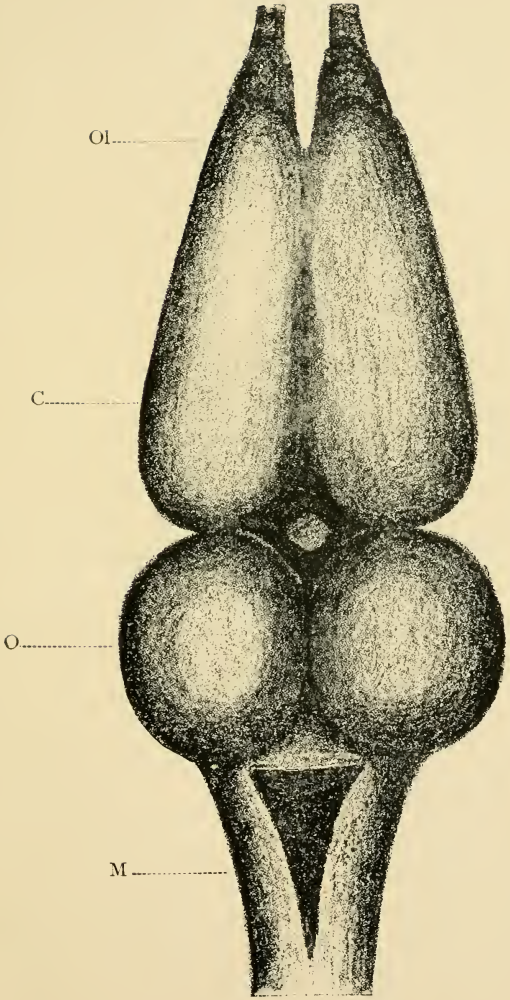
in making them entirely helpless, for they not only avoided obstacles in their path or in their flight, but appeared to fly from one place and alight securely on another.

As we ascend from birds to mammals, however, the development of the cerebral ganglia, as they are termed, grow from mere bulbous swellings into great masses, which cover more and more the sensory ganglia which we have been considering, until, in the monkey, these are wholly buried under their mass, with the exception of the cerebellum. In man even this exception no longer holds, and so insignificant relatively are those original centres, at the base of the skull, that we are accustomed to leave them out of consideration and to speak of his cerebral hemispheres as his brain.

Being the terminal masses also of the nervous system, the gray matter in the brain is not surrounded by tracks of white fibres, but is spread out on the surface, and all the white fibres, both afferent and efferent, radiate from it down to form their connections with the basal ganglia and with the centres in the spinal cord. The gray matter in the higher

animals is so abundant that it has to be thrown into folds to make room for it in the cavity of the skull, and hence occurs that appearance on the brain surface of eminences separated by depressions, to which the name of convolutions is given.

In man they are extremely numerous, and, at first sight, so complex and irregular that it would seem hopeless to differentiate them. But a careful inspection shows that the deeper depressions are very uniform in their occurrence, so that the surfaee of the brain can by them be mapped out into definite convolution areas, and, what is very interesting, the monkey also possesses them all, convolution for convolution, identical with man's. More than that, the functions of the different convolutions, whether related to afferent or efferent duties, have been determined to a very considerable extent, so that we can fix, in the different series of the mammalia, the respective areas which correspond to the different functions in each, as, for example, the visual or sight-perceiving area in the rabbit, cat, dog, monkey and man. This enables us,



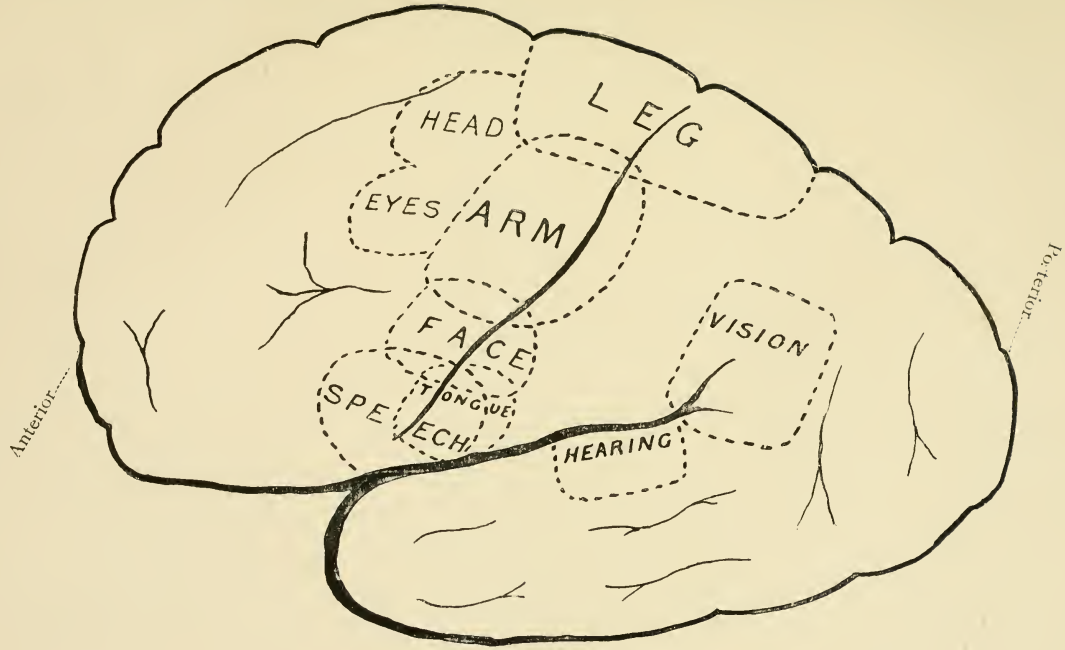
BRAIN OF A FROG.

by direct experiments on the brains of living animals, and in man by observing the locality of disease in certain definite parts, to come very close to well-demonstrated facts about many of the most important functions of the great physical organ of the mind.

In plate 5 we have a diagram of the brain of brains, or that of man, which, as we remarked before, in its development overlaps everything. On this chart are represented the areas in the left hemisphere, which are the last material seat of the mental functions of perceiving and of doing—that is, of directing movements. The posterior lobes are largely taken up, as you see, with vision. The nerves of sight, after many communications with lower ganglia, finally end here. These lower lateral lobes, on the other hand, are occupied with the business of hearing. Above the deep depression which bounds these hearing lobes comes the antero middle area, which subserves the great motor or efferent functions of the cerebrum, with the seats for moving the tongue, mouth, face, hands, fingers, arms and finally the leg, arranged in succession from below

upward. The areas for moving the eyes and head are above and in front of those for moving the arms. So well-defined are these different areas that we take advantage of this fact to locate exactly, and if need be to cut down upon each area when a spasm or paralysis in hand or foot indicates that we have a corresponding mischief in the brain which a surgeon may remedy. The areas for the senses of smell and of touch and the motor areas for the trunk of the body cannot be shown in this chart, as they are on the lower and inner face of the hemisphere.

Now, as regards the functions of the brain and their relations, the first conclusion we come to is that an unmistakable promotion, so to speak, has occurred in the mammalian brain of the great functions of sensation, consciousness and the power of directing movement, from the basal ganglia of fishes, amphibia and birds up to the great cerebral ganglia before us. Remove these from a mammal, as we have seen that we can do from the fish, frog and bird, and the mammal is then very far from acting as if he had still



CEREBRUM OF MAN.

the same degree of consciousness or power of movement left which those lower in the scale have.

This does not prove that the cerebral ganglia have entirely superseded the original basal ganglia, for facts of disease at the base of the brain and of the medulla in man, show that, even in him, these original nerve centres still hold much of their old relations. But the case is very much like the history of many a prosperous firm which began business in a very small way, and in humble quarters, and then when it branched out to an undreamed of extent from its lowly start, the highly trained heads of the firm are found to have moved up to large and commodious quarters on the upper floors, while the original routine work is yet done, as of old, in the story below. Habit, or routine, is quite enough now for the basal ganglia, while consciousness is needed to go up higher, where the vastly wider operations of mind have to be carried on. Nevertheless, it is the same old firm yet, for we will find that its principles and modes of doing business, by the

heads of the establishment, have not changed, though they are now handling millions, where they used only to deal with a few dollars.

We may think, for example, that in ourselves the majestic range of our memories, imaginations, feelings and ideas, must have a very different genesis and be according to very different laws from the simple, unconscious functions of the first example of a nervous system which we described, but, a little attention to the source and sequence of our ideas, even when taking their most extensive range, will show a quite unmistakable correspondence to the old original methods of nervous business.

A decisive illustration of this kind is furnished by the genesis of the great human faculty of speech. We need not waste time by saying that if human speech can be shown to be dependent on a nervous mechanism, located in the brain, which is as plainly made up of its afferent, centric and efferent parts as any centre in the spinal cord, that we need not seek to prove our proposition by anything else. Human speech! What higher

illustration of what mind is and does, can be named when we think of what has been said by human tongue or expressed in written word? But human speech, even in those most gifted with it, can be both partially disordered or utterly ruined by definite and strictly localized injuries in brain substance.

A well-educated patient of mine found one morning, to her utter amazement, that she could not read a word in newspaper or book. Her attention was drawn to this strange fact by her trying to write a few sentences, which she did correctly enough, but then discovered that she could not read a word of what she had written. She thought at first that something had happened to her sight, but soon found that could not be so, for she could see everything but written or printed words as well as ever. Meantime, she could talk as fluently and with as clear understanding as ever she did. On the other hand, there are many recorded cases in medical literature of persons who could read as well as ever, but who, just as suddenly as in my patient's case, could not understand a word that was spoken to them.

Their native language had become utterly foreign to them when uttered in their ears.

These two derangements of speech, or "aphasias," as they are technically termed, are called respectively word-blindness and word-deafness; the eye and the ear in typical cases being as good as all other eyes and ears for everything except words. Such cases of aphasia, therefore, prove beyond doubt that human speech has its afferent origins, one by the afferent acoustic nerve for spoken words, and the other by the afferent optic nerve, for reading and writing. In each case, of course, they must be totally distinct in nature from each other. The sound of the word *man* and the appearance of the word *man* in writing must be so intrinsically different in nature that they must have very different places in the brain to correspond.

And so they do. A sufficient number of post-mortem examinations have been made in cases of word-blindness and of word-deafness to show just where the ear registers spoken words and just where the eye registers the words which it reads. But much the

commonest form of aphasia is where the pitiable patient can both hear that which is read to him and what is put before him, with clear understanding, but, though (therefore) his language-hearing and language-seeing centres are unaffected, he is totally mute; not a word comes from his tongue, when he tries to speak by it, nor a word to his hand when he tries to write by it. He can be addressed by others, but he cannot answer. Here it is outgoing speech which is annihilated while ingoing speech is preserved. But what is outgoing speech but efferent speech? What is ingoing speech but afferent speech? And, to make the demonstration complete, this efferent form of aphasia has its definite seat also, and now to be found, as it ought to be, in the motor or efferent region of the brain, in a convolution of the motor area called Broca's convolution, from a distinguished French physician who first identified it.

Here, therefore, we have a complete demonstration that one of the most intellectual endowments of man is dependent upon a perfect piece of mechanism in his brain, arranged

like all other nervous mechanisms down to the lowest in the nervous system. We also find that we can damage that mechanism, piece by piece, and thus damage speech piece by piece as well. Certainly this looks very much like things intellectual depending on material structure. But more of this is to come yet.

We have omitted to say before that the brain is divided into two symmetrical halves, and that the right brain receives all the sensation from, and governs all the ovluntary movements of the left half of the body, while the left brain similarly receives the feeling and governs the right side of the body, the afferent and efferent fibres for both these functions from each hemisphere crossing over to the other side at the base of the skull, in the medulla and in the cord. Now it happens that it is the left brain centres only, in the great majority of persons, that have anything to do with speech. But not in all persons. In some persons it is the perfectly corresponding right brain centres which have to do with language, and not at all the left. This is a

very significant exception. What does it mean?

It means this, that when the speech centres are disordered in the left brain, those persons were right-handed, and when it is the right brain centres that talk, then those persons are left handed. But what has right or left handedness to do with the origin of speech, so that the left brain speaks in right-handed and the right brain in left-handed persons?

Here comes our old friend Habit again, and he says, most truly, I am the organizer of everything in brain as well as in spinal cord. I found these human beings wanting extremely to talk, and they began to use their right hands in gesticulating to make their wants known to their fellow human beings. So next to the brain centres for moving the hands and arms were the centres for moving the muscles of the face and mouth, and hence, as they tried to talk with the hands and arms, so they then added making faces to making gestures. But the centres for the muscles of the mouth are also near neighbors to those of the tongue, and, so in time, they added the wagging of

their tongues to their gestures and grimaces, and, having begun on the right side of their bodies and the left side of their brains, they have kept on doing so, by my direction, ever since. But those originally left-handed fellows, of course, started with their left hands and hence in them I have organized their corresponding right brain centres. There are whole nations and races still who are practising my original lessons with gestures in talking to as full an extent as with their tongues. Thus the Aino of Japan says *man* with his tongue, but when it is accompanied with a mean gesture, he means *woman*; and when a Frenchman or an Arab is talking, how much of what he says would be left out if he did not gesture?

So it seems that habit has organized human speech, as a material mechanism, just as he organized a spinal centre, and much, therefore, have the materialists made out of his testimony. But it is our turn now to cross-examine him. Habit, you always work with an afferent impression, not so? Yes, always with incessant outside impression. Well,

when you started to teach the left convolutions to talk, where did you get your afferent impressions from? Well, to say the truth, I had to get them all from inside, in nine cases out of ten. What do you mean by getting the teaching afferent impressions from inside?

Why, that these human beings had meanings or ideas to express first and efferent gestures afterward, then they also had meanings first and grimaces afterward, and then again they had meanings first and sound-words afterward, and finally, after a long while, they devised visible forms for eye-words; that is to say, that meaning preceded gesture, grimace and sound, just as meaning preceded the symbols of written words. You say then that you did not teach them by the afferent sense of hearing sounds first, and then afterward they got to know the sounds had meaning? No, I teach parrots sounds first, and then they slowly find that the sounds have meanings, but human beings always mean something first and try to talk afterward. Their language, therefore, is always by symbols, which are nothing in themselves any more

than a paper dollar is anything more in itself than a piece of printed paper. That is why I cannot teach language to other animals than human beings, because they haven't enough inside their heads to make symbols with. No—not a symbol! Dogs can only bark or whine forever in the same way, but men never end in making a Babel of languages, because their languages are made up of perfectly arbitrary symbols utterly disconnected with the outside world.

To drop this metaphor we may point out, in the first place, that Broca's convolution in the other half of the brain never learns to utter a word. In a right-handed person who speaks our language, his right Broca's convolution can no more speak English than it can Siamese, for when his left speech-expressing centre is diseased he becomes totally speechless. The reason is that speech is not the original endowment of either these left or right brain centres, but has been acquired by one of them through teaching, and that teacher, as always in the nervous system, is early habit by some means started as such.

The fact that it is started according to the most used hand, and not according to a superior original endowment of the centre, is proved by the absence of the slightest sign of difference between this pair of centres in primary endowments, for otherwise the unused centre would show some capacity for speech, instead of none at all, just as the left eye and left ear are not appreciably inferior to their more used fellows. We may also point out that this anatomical fact completely disposes of what is called the bow-wow theory of the origin of language, as it shows that human language did not begin with a series of imitative ejaculatory sounds, but with the use of the hand in gesticulation. But the use of the hand is a purely efferent act. The source of this act must, therefore, be looked for within the consciousness, and not from outside.

When the hungry Stanley tried to converse with a Congo tribe, as he describes the scene, he pressed his stomach, brought his right hand up to his mouth, opened that and made a series of woebegone grimaces with his face, ere he pressed his collapsed stomach again.

Certainly the sounds which these Congoites made as words rang in his ears, but what use were those afferent impressions compared with his most efferent gestures? But those most expressive gestures had a meaning precede them in his brain, and so all linguistic signs, gesticulated, spoken or written, have to be preceded by truly centric purposes.

This centric origin of languages is testified to also by other facts of disease. Thus, it is common for whole classes of words to be lost in some forms of aphasia, while other classes remain. I have a patient now who has lost all her nouns in a batch, but has retained her verbs. On showing her a pen and asking her what it was, she answered, "What write with"; then a scissors, she answered, "What cut with." So it is usual to find in such cases a significant order in which words are lost.

Thus a speechless patient was brought to my college clinic whose case, on examination, I said was probably quite curable, and, after he withdrew, I told the class that we would see, if he was cured, whether he would not

recover his language first with prepositions and participles, then the verbs would come back, and last of all the nouns. And so in time it proved. He first uttered "up," "down," "in" and "out," then, after some weeks, he began to get back his verbs, and last of all his nouns. The explanation is this:

Verbs are the names applied to events of personal experience, such as "I am." "I heard," "I felt," etc. We have the personal experience within us first, and, therefore, we conceive of verbs first. It is after this inner experience that we then settle what we see or what we hear or feel, which, of course, is itself an object external to us, and hence named after the experience as a thing or noun. Proper names or names of persons. for example, are just as much nouns as any other nouns, but, because they are learned last, they are the first to be forgotten.

And so nouns in general, because they are learned last, that is, after verbs, being more exterior than verbs, are forgotten before verbs.

Anyone who finds himself at a loss for a word may prove this for himself, by discovering that the wished-for word is very rarely a verb, but almost always a "what you may call it," namely, a noun.

But deeper down than verbs, and far more exclusively human than anything else, is the truly wonderful preposition. It is neither the name of an object nor of an experience. It is that which only the royal mind of man could think of making a symbol for, and it testifies to what he is, for it denotes a purely abstract relation, and only man can conceive of abstract relations.

With his prepositions he can step easily from one end of the mental world to the other, using only one noun as his staff. Thus *scriptio* is a noun, "a writing," but an ascription is not a conscription, nor a description, nor that an inscription, nor is a prescription a proscription, nor a superscription a subscription. But where could Habit, with its outside teaching apparatus, find a way to those depths of human consciousness which begin to perceive relations with the

earliest perceptions of anything? If Broca's convolution is taught by habit, as it evidently is, where is the real teacher who incessantly keeps up the deep habitual working? The only answer is, conscious impulse from within, not surface impression from without.

It is vain, therefore, for writers to urge that monkeys and dogs can be made to understand language, and that monkeys can even learn to utter word-meaning sounds. For no one doubts that these animals can be taught tricks, and why not sound-tricks also, especially when emphasized with tone and visible sign which they carefully watch in the master's face and hand? But the argument is that man does not need a representative anything from his external world for him to make his words out of, so that if ever human speech began with representative sounds, it soon stepped freely away to arbitrary symbolic sounds, invented, not imitated. Let our experimenters, therefore, instead of setting animals to imitate, set them to invent words, for that would decide whether the origin of language is external or internal. Where, for ex-

ample, did the Arabs get out of their dull camel the more than a thousand names in their language for him? The monkey has Broca's convolution identical with man's, but what is there in him to teach it? The source of true symbolic speech is as limited in him as the capacity for the invention of quaternions, for the power to conceive the question "how" (not why,) enough to choose a symbol for it, carries with it the power ultimately to weigh the fixed stars.

But the materialist now starts on his search for this great source of mental manifestation and begins by pointing out that the brain of man is very large and very convoluted. It is true that modern physiologists have used up the greater part of the surface of the brain by appropriating most of its areas to purely sensory functions behind, motor functions to the middle and the front, and leaving only the extreme anterior lobules for something not yet demonstrated. But then, reasoning from the facts of comparative anatomy, do we not find that the size of the cerebral hemispheres and the number of their convolutions are in direct

proportion to the increase in intellectual function and power? Certainly we do, but not, however, that the mental endowments both in degree and in quality will depend upon the amount and elaboration of nervous matter. For the argument is—the more brain matter you have and the better it is organized, the more mind you will have and the better developed it will be. Add more wires to your Eolian harp and you will have more music by half than when you have only half the number of wires. But, alas! there is one anatomical fact which, at a single swoop, will cut down this theory to its roots, leaving only a stump for anything to grow out of it again, and even then it must be much modified from its original shape.

That fact is this: We have all along been using incorrect language in speaking of the brain as if it were a single organ like the liver or spleen. We, as everybody else does, have done so simply for convenience, as we say that the sun rises and sets, when, in fact, he never does either. What we should, in accuracy, say, is our brains, for there are two of

them, like our two eyes, and our two ears, and, like those pair organs, they exactly correspond, lobe for lobe, convolution for convolution and fissure for fissure.

But, as a distinguished physiologist writes, as far as mental manifestations are concerned, we are totally in the dark what we have two brains for. But if we do not know for what mental purpose we have two brains, we can at once say that we know what they are not for. They are not to double our mental capacity, nor does one brain add a single new faculty to what the other has, nor a new power, except as in speech, when one has gained a faculty by habitual use as an instrument. But the corresponding parts of the other brain could gain the same faculty, if only they were so used from early life.

When not used as instruments, therefore, both brains are exactly alike, and can do no more than other pair organs in their working. There is, hence, no more reason to conclude that the right brain can, by native endowments, do some thinking which it can add to the left brain's thinking, than to suppose that

one eye can see blue and the other eye see red, or that a man can turn one ear to hear English and the other ear to hear French. But from the materialist's point of view, if you double the quantity of brain matter you double the thinking stuff. That would be like giving a man two stomachs. Our one stomach has over five million gastric follicles to secrete gastric juice with. Now, if he had two stomachs, he could have over ten millions of these glands to make just so much more gastric juice with. He could then digest two dinners instead of one. Is quantity of cerebral matter, therefore, like this? Or if a man should lose one of his two brains would he thereby lose half his consciousness or thought? The facts of disease indeed show that we have two brains just as we have two eyes. One eye can do all the seeing if necessary. It is only as a matter of convenience that we have two eyes, not because they see anything, but because they are the instruments of sight, and on account of their position simply is it a great convenience to have two instruments exactly alike (because they work exactly alike)

than to have only one. The same may be said of the two ears. Why, therefore, may not these two brains that are exactly alike, be also the two instruments, and nothing more than the instruments, of consciousness?

We come now, in conclusion, to the last great problem which nervous function presents, and to judge which path of inference it indicates that we should choose. It is impossible to overlook this problem in the consideration of the nature of consciousness, because it is stamped with the attribute of invariability, and invariability is always of fundamental import in whatever connection it occurs. In every discussion, therefore, the strategic importance, so to speak, of the invariable, should always be appreciated, for a little reconnoitering may show that it dominates the whole field. Now, such an invariable element is found in the facts of personal consciousness, perfectly unique in kind among all the facts of life, and never-failing in its occurrence, and that fact is that consciousness is always *intermittent*. There is no such thing

as continuous consciousness. Instead of that, at definite intervals it absolutely ceases.

The great bearing of this fact on the whole subject under discussion is shown at once by asking this question, Is sleep abolition of consciousness, or withdrawal of consciousness—which? If abolition, then sleep, so far as personal consciousness is concerned, is intermittent death. If so, then death itself is truly unending sleep. But if in sleep, the consciousness only withdraws for a time from its relation to a material organism, so may death itself be but a sleep in the sense of being the withdrawal of the personal consciousness from a material organism, and nothing more.

But, first, we said that this fact about consciousness is unique. Some may suppose that the whole body sleeps as consciousness does. It does nothing of the kind, it only rests, which is a very different thing, and it does not do even that in those parts which the consciousness does not use. It is significant that only those parts and those organs which consciousness has been employing and

dominating grow weary and worn and cry for rest. Everything else, and particularly in the nervous mechanism, which consciousness does not interfere with, goes on working without needing any rest. There is the medulla. What an immense labor it keeps on performing uninterruptedly, equal to raising 500 pounds an inch with each deep breath, while the body is supposed to be sleeping. We have also heard that flowers sleep. We might as well say that a room sleeps when it is dark, for flowers close up only when the stimulus of light is withdrawn. No, it is consciousness alone which sleeps. Certainly no other process of life shows anything like true sleep. Nutritive processes whether for repair or for growth, instead of ceasing in the quiet of night, are quite as active, if not more so, then. The circulation goes on just the same. The rest also which organs seem to take when their work is done, as when the stomach is through with its task and remains empty, is certainly not sleep, but simply because for the time no more added nutriment is needed. But consciousness does not cease

because no more consciousness is needed. It ceases simply and solely because its presence is fatiguing.

Nothing else in life fatigues but it. We might, therefore, impersonate the brain as speaking to consciousness thus: See here, Consciousness, we have to come to some understanding about our mutual relations. You are the only fatiguing quantity in the case. Especially your recent portentous development which you call the Will, is perfectly unbearable to all my old faithful nerve centres, any of whom can jog along without once complaining in their work, but so soon as this will of yours commences to intermeddle with them, they begin to know what fatigue is. Here is my tireless medulla, if your will begins to order him in his business, and tells him how to breathe according to will and not according to his old director, Habit, he becomes exhausted in less than half an hour. I cannot even wag a little finger steadily by the will for twenty minutes without the spinal cord sending word that it is more fatigued by that small muscular work

than by working the big diaphragm for a week. Therefore, we must arrange that you will have nothing to do with me for at least one-third of the term allotted for our co-partnership, so that I may have time to recover from your presence.

This great fact of life indicates that consciousness is to the brain what the rider is to his horse. While he directs the horse in all his ways, he is neither the horse, nor a constant part of the horse, but so different from him that it is his burden which wears the animal out and makes it necessary that he should dismount at stated intervals and let the horse alone.

It is only on that account that consciousness ceases, for cease it does, absolutely. There are many loose ideas about consciousness in sleep, for many persons, deceived by its complete return after sleep, imagine that it only apparently ceases during sleep, and that somehow it hangs around, as active as ever, only that we do not know it. But if it hangs around, as in dreaming, then it is not real sleep. Good, healthy sleep involves

nothing more nor less than true absence of consciousness from the brain.

Now, what does this invariable fact about consciousness mean? Only two answers can be given to this question, and only one of them can be true. One is that personal consciousness, meaning by that the sum total of sensation, perception, emotion, thought and will, "the individual, in fact," is a function of the material brain, and, therefore, the product of molecular vibrations in brain matter which have to be periodically suspended in sleep or the molecules get out of order by too incessant use in that particular way. When the molecules, therefore, do get so out of order, consciousness is abolished. But we must insist on a correct use of the term brain, now, and remember that consciousness wears out not the whole brain, but only some of the upper ganglia, perhaps of only one hemisphere at a time, flitting from the left to the right brain as most convenient.

We ask next, does not this hypothesis necessitate the statement that every time a Shakespeare, a Napoleon, a Lincoln, a Com-

modore Vanderbilt, or a Helmholtz awoke from sleep he was virtually recreated again, or at least came into existence from non-existence once more? In answer to this, the Eolian harp illustration, of course, must be used, though we seemed to have done with it when the anatomical fact of doubling the wires with two brains showed no increase in the music. According to its analogy, the wires may be conceived of as becoming so shrunken by the cold of the air currents that their molecular arrangements became deranged and the harp had to be withdrawn till the wires resumed their normal temperature and tone again, when the harp would be just the same as it was before. But does this analogy give us the simplest explanation of the two at this particular juncture?

We must leave our hearers to judge. The violin analogy is that the musician simply lays his instrument down, to take it up afterward, the same musician as before. Once again, let us here interpose that the violin itself behaving badly sometimes, and therefore, thus affecting the music, has nothing to do

with the question of the existence of an independent musician ; for, if, when he tries to play with it, he finds that some one has put beeswax on the strings instead of rosin, the consequent poor music does not go to prove either that he is a poor musician, or that there is no musician. The argument often harped upon by materialists that material changes in the brain are accompanied by corresponding changes in mental manifestations, has been answered often enough already, and has no place now.

The question now is, which analogy, that of the Eolian harp, or that of the violin and its musician, best explains awakening from sleep? We incline strongly to the latter, for these brief reasons: The Eolian harp, when it awakens, gives out only one kind of music. It is inconceivable, in the true sense of the word, how it could be arranged so as to vary as the violin does when the musician has hold of it. Could it be arranged to play one symphony from Beethoven and then right afterward one from Mozart, and the overture of Tannhauser next? The range of sympho-

nies which this human violin plays, every time it comes back to consciousness, are varied to infinity. Have the brain fibres, meanwhile, in sleep, been varied likewise to infinity?

Every one instinctively feels when confronted with the practically infinite in human consciousness, that the material element in the question is hopelessly inadequate to carry us far toward an answer. We have found how emphatically this has been said by Tyndall, by Allison, and admitted even by Romanes and by Huxley, that the chasm of the difference between the sleeping brain and the conscious brain is impassable by any material bridge. Consciousness is absent in the one case and present in the other, and when it is present can the universes wide range of human thought be solely and exclusively dependent on the arrangement of those collections of nerve fibres and nerve cells, which after all are just those of the chimpanzee?

If the facts of human personality depend upon fibre and cell for thought and action, where are the fibres, cells, and convolutions added to those of the chimpanzee to corre-

spond to the thoughts of the genius in mathematics, in statesmanship, in commerce, in engineering, in invention, in art, in poetry, in science, in philosophy and in the rest of the great consciousnesses of the great human world?

No, the facts of sleep and awakening point more, in our opinion, to a visitor from the outside who can take up one of the two instruments, as he chooses, in the human music hall, and can play with them any variety of melodies, because it is he and not the instrument who is the real cause of the music. But certain facts of physiology oblige us to change our figure somewhat. Consciousness is called back from sleep by afferent impressions. It is very much like ringing up the clerk in a central office station by so many telephones. Late at night, after incessant ringing all day by different wires, he says: "That last ring is through the ear station, and it sounds twelve o'clock. I will shut up the office now and go, though it is not I, but the batteries which are getting exhausted. When they are re-charged by morning let them ring me up

again." It is the afferent that brings the consciousness to its present earthly business place.

A boy in Germany attracted much attention among biologists because he had lost all sense of smell, of hearing, and all sense of touch or feeling, and the sight of one eye. His afferent impressions were therefore all gone except that of sight by one eye. As soon as that was closed, he at once dropped to sleep. Did his personal existence, therefore, depend wholly on that one eye? or does not his case rather show that the personality simply has to have at least one point of contact with the material organism, and that it can get along even with only one?

That outside visitor, so unlike everything in the material machine that it is only his coming and working it which wears it out, is objected to by Romanes and Huxley because they dislike the name *spirit*. The thing itself meanwhile they are constantly talking about. It is the name *spirit* which they try to down. Call it psychic force, or some such name, and very probably they would be satisfied. Romanes says to talk of it acting on

the brain is to interfere with the conservation of energy; as if the whole energy in a machine cannot be conserved, and yet that energy be divested from without by a child's finger pressing a button. Huxley objects to it because he cannot think of it as something carried under a man's hat, but devoid of relation to space, indivisible even in thought, and yet in that place and possessed of half a dozen faculties, and yet having not even a geometrical figure! Well, a piece of iron has something in it which makes it point to one star in the heavens, to the salvation of every ship, but it is shut up in a small box, which may be hung to a watch chain; it serves great purposes, and yet that something in it is indivisible and has no relation to any of the three dimensions of space, and, finally, it has no geometrical figure! The simple truth is that we are not half so helpless about our inferences as to the independent existence of mind, as the congenitally blind man is as to the methods of spectroscopic investigation.

With one illustration we now end. A piece of money is one of the smallest things

made by man, but how much does it testify to in him, as a creature with laws, fixed institutions and ideas of value utterly beyond the highest mental range of the most intelligent brute! Lately a statesman stood up at a festive gathering to speak of the most complicated questions connected with the standards of value, which would affect the wondrously complicated interests of 60,000,000 of a most intelligent people. How much was that brain thinking about just then! But suddenly the tongue faltered, he fell, and in a moment he was gone. Now in all this world of great changes, no change is so great as this between the brain just before, and just after that fall! Physiologists, we have seen, admit that they cannot tell what the essential change was there, even in the material part. We prefer to say, in the sense of the words as they occur in those sacred pages, in which so often we seem to read what could only come from beyond the limited horizon here, "He fell asleep!"

To sum up. The writers from whom we have quoted, emphatically tell us that as biol-

ogists they cannot pronounce mind to be the product of matter or of energy (force), because neither of these factors can be compounded into consciousness. They tell us that consciousness is so generically distinct from matter and force that not a single analogy can be instituted between it and them, much less a casual relationship. We conclude, therefore, by every rule of thought and language, that each of these three must be distinct realities, for if one is not the other it must be itself, and does not lose anything of its own by entering into relations with the other. But when we draw this natural inference of the independent, as well as the relational, existence of mind, our authorities become much confused. Romanes says that to speak of mind acting on the material brain is nonsense, while Huxley says that consciousness is a function of the brain. Both agree, however, that consciousness cannot be a separate entity, for that would be equivalent to admitting that there is such a thing as spirit. With Huxley, a spirit is inconceivable, because he cannot conceive of any-

thing apart from qualities, and as he thinks that a spirit is something apart from every quality, material or otherwise, he finds this name leads him into an intellectual vacuum. Romanes, on the other hand, equally rejecting spirit, finds a restful conclusion in the Inexplicable. The reader, having kept their company for some distance, is then told that they decline to go beyond the conceivable and the knowable, for science deals only with what is so, and it is well and wise to recognize when we can be knowing ones no longer, and must be content to remain unknowing or agnostic.

All this would be well if these gentlemen had been talking of things knowable. They rarely have done this, however, and, instead, only of things inferential. But inference is always provisional, never final. Any new fact added to the bases of inference may require an entirely new re-arrangment of the inferences. Thus scholars long inferred that the Homeric poems were not reduced to writing till the age of Pisistratus, but this theory has been materially affected by the

recent discovery that ancient Greek colonists in Egypt used writing as far back as the reputed age of Homer himself. Now, with the fact obstinately remaining that mind is a great reality, Huxley himself often maintaining that it is the first of all realities, what is there inconceivable about its separate existence, merely because we are unacquainted, at present, with the conditions of such a separate existence? On account of that one deficiency, must we suspend further inferences and return to matter and force, which already we have been told can give no intimation of what mind is, although we know that there must be such a thing as mind? Should we not rather be sure that all bases for inference in our subject are exhausted before we agree thus to leave off with no conclusion whatever? Certainly we do not see why the word "inconceivable" should act on us as a spell now, when no biologist allows himself to be daunted by it in other investigations. For does inconceivableness arise only here and nowhere else? Not to speak of mind, how conceivable, in any sense of the word, is the

relation of life itself to matter? Thus with a whale, great as his relations to matter are when he is full grown, yet, like every other mammal, he begins his individual life with no more matter than a bacterium, for, however uncountable the millions of the cells of his adult body be, he commences as a unicellular being. Yet he is as much a whale when he is microscopic in size as ever he will be afterwards. In fact, when his material body is too small to be seen by the naked eye, dwelling in an ocean of food, the size of a pin's head, he is a greater living thing than when his bulk is more than that of two thousand men, because by that time he has outlived most of the capacities which were in that vanishing speck of matter with which he began. In that little mass of protoplasm there was something which not only determined how every cell in his future body should come into being, even as parts of legs and feet which he would never use throughout his life but keep tucked up deep within his body; but, doubtless, also that he should develop some things derived, not from his parents,

but from his grandparents. Moreover, these were not mere potential properties of his unicellular body, but parts as actual as that one atom of hydrogen and one of oxygen, and not one of nitrogen, are united in a molecule of water, for not only is it impossible that this material speck should grow into a bird, or even into a fish, but perhaps a mistake, so to speak, has already occurred in it, which will develop a hereditary tumor in him after he is full-grown. Such biological facts about the relations of life to matter are to be accepted doubtless, because they are so conceivable! The truth is, that whatever reasons there be, and they are many, why we properly should confess ignorance or agnosticism about the relations of life and of mind to matter, of the conscious to the unconscious, inconceivableness of the conditions is about the last consideration to be adduced and the least worthy to weigh in the problem.*

* Here is the latest dictum from a scientific quarter on this subject:

"The influence of animal or vegetable life on matter is infinitely beyond the range of any scientific inquiry hitherto entered on. Its

2. We object to consciousness being regarded as a function of brain matter, because no materialist could ask for more than such an admission. Such an admission involves the conclusion that the brain is not the instrument, but the cause of consciousness. Nothing can be both an instrument of a thing and the cause of that thing, also. Steam causes the engine to work, but its instrument, the engine, does not cause steam. Now the brain mechanism is as much built up by food as the muscular and the glandular mechanisms are, and the source of the energy shown in their function or working, is in each equally to be traced to the alimentary canal. If mind, therefore, instead of using the nervous mechanism as its instrument, is rather produced by the working or function of the brain, then mind is ultimately the product of eating and

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power of directing the motions of moving particles, in the demonstrated daily miracle of our human free will, and in the growth of generation after generation of plants from a single seed, are infinitely different from any possible results of the fortuitous concourse of atoms. The real phenomena of life infinitely transcend human science."—SIR WILLIAM THOMSON, now Lord Kelvin, President of the Royal Society. Article in the *Fortnightly Review*, March, 1892

drinking. On the other hand, that indigestion may affect both feeling and thought is no evidence against the brain being only the instrument of mind, for the working of any instrument is affected by disorder of its proper conditions.*.

3. Inspection of the nervous mechanism from its simplest and lowest example to its highest, shows that it is purely a mechanism. From first to last it is a machine, and therefore while giving evidence in its most perfect forms of the presence of consciousness, so, like any mechanism, it does not afford the slightest clue as to the nature of that which works it, namely, the consciousness, any more than an

* Dr. J. Hughlings Jackson, F. R. S., the distinguished English neurologist, though he presses to an extreme, as I think, some evolutionary hypotheses, in explanation of certain nervous disorders, nevertheless remarks on this subject:

"Function is a physiological term, and it is, I submit, improper to speak of states of consciousness as being 'functions of the brain'; we can only say that states of consciousness attend functions of the brain, of those parts of it, at least, which are the highest cerebral centres . . . . It is not the mind, but the physical basis of mind, which is a product of evolution. It is the organ of mind, not the mind, which, being an evolution out of the rest of the body, is representative of it."—"Lectures on the Comparative Study of Diseases of the Nervous System," *British Medical Journal*, Aug. 17, 1889.

engine reveals the engineer. This is illustrated by the intellectual faculty of speech. This human faculty is as much dependent on a mechanism in the brain as the breathing is on a mechanism in the medulla, and therefore may be specifically deranged according to specific anatomical changes. But different from the nervous respiratory mechanism, the speech mechanism owes its origin, elaboration and perfection wholly to the consciousness. It is not born with any human being, and therefore differs fundamentally from the means of communication by sounds of other animals, who communicate with each other by sounds which are the same for the same species wherever they are; or in other words, they are born with them. The human consciousness, on the contrary, selects one of two exactly similar regions of the brain which it trains as instruments of speech. Which of the two is determined by the accident of the most used hand when communication with others was first attempted by gesture. But human speech indicates its high and sole source in the unapproachable human con-

sciousness, by its actively inventive, instead of its passively imitative, character, by which it is enabled to choose perfectly arbitrary symbols for its terms. Hence the endless variety and change of human languages. Thus it has been estimated that among savage peoples, whose languages are not preserved by writing, the lapse of only ninety years suffices to make unintelligible the speech of their predecessors. This shows how hopeless it is to attempt to trace back speech to primitive ejaculatory sounds, for if this could be done it would be among such savages that the primitive sounds would be found. But the selection in right-handed persons of certain areas of the convolutions of the left brain to act as the instruments of the mental function of speech, strongly indicates that the rest of the convolutions are instrumental also, and that they are not endowed with any native capacity for thought, any more than the unused convolutions of the speechless half of the brain are capable of spontaneously registering or uttering words. It is the consciousness therefore which makes the convolutions

receive impressions and formulate ideas, just as it is the consciousness which makes certain convolutions receive and enunciate words. If one part of the thinking brain is thus the instrument of consciousness, then all of it can be so.

4. This conclusion is further borne out by the brain being a double or pair organ. It is plain that the possession of two brains no more gives a double capacity for thought than the possession of two eyes doubles the capacity for sight. But such would be the case inevitably if thought was produced by the brain cells, for then the more cells the more thought, and twice the number of cells would give twice the number of ideas, or increase correspondingly the amount of thinking. No physiologist, however, will entertain this idea for a moment. Instead of that it is plain that the consciousness can use one or the other of the hemispheres of the brain, or both together by means of the three commissures or bridges between them, as it uses one or both eyes by means of the optic commissure. Some physiologists, indeed, from the evident fact that one

brain can do all that is needed for thinking, are unable to explain why an extra brain is provided.

5. Prof. Tyndall, in a celebrated address, once intimated that human consciousness may pass into utter non-existence, by speaking of certain things as abiding when himself and his hearers had "lapsed into the infinite azure of the past." But we do not need to regard consciousness from any blue distance to find it cease altogether, for it does so normally every time we go to bed. What becomes, then, of this great reality, this third thing in the universe of Huxley? If consciousness cannot be conceived of apart from qualities, in sleep it has no qualities whatever; that is, it does not give a trace of a manifestation of existence. If on that account it is for the time non-existent, then anything more phantasmal than this third thing in the universe cannot be imagined. A great reality which becomes complete unreality every sixteen hours! When asleep therefore, all men are neither virtuous, nor vicious, nor intellectual, nor simple, nor anything else, for they are all equally non-existent in every mental and moral respect.

If the cessation of consciousness in sleep means abolition of consciousness, all these statements, and many more like them, must be true. The greatest genius the world has ever seen must have been not only an intermitting one, but a pure nothing for a third of his life. But instead of this recurrent vacuum theory of consciousness, we can equally regard sleep as a significant sign in the brain that its consciousness is virtually an outsider, for the brain never tires with any work of its own. It cannot do both its own work and also carry consciousness continuously. Every other work of the physical mechanism, including the nervous portion of it, can be carried on uninterruptedly except when consciousness takes part. Why that "except," unless the conscious work has in it an intrinsically different, and therefore foreign element from any other natural operation of the body? This is particularly shown when the consciousness is most imperious in its interference, by directing the brain to think, and the muscle to contract, by will alone. It is then like a rider putting his horse to a run,

and only a strong brain can keep up thinking by will alone even for one hour.

The only answer of the materialist to the conclusion that the consciousness does not cease to exist, though it vanishes, in sleep, is—but where does it withdraw to? It withdraws, we reply, to where it comes back from; coming back the same as it went, and not a new existence every time the brain cell feels the stimulus of its presence. It can exist without the brain, just as in sleep the brain exists without it. He who denies this, denies it solely on account of the mental infirmity of incredulity, not on account of the mental virtue of skepticism. Incredulity is based wholly upon supposed personal experience, and will believe nothing else. Hence it cannot be reasoned with, as it is always scornful in its reliance on this often most fallacious testimony. A company of Asiatics once tried to laugh me down for saying that the earth turned over, because they had never experienced its doing so and were sure the sea would be spilled in the process. This mental trait often equally illustrates its nature as a mental weakness, by the

same persons who are incredulous about some things, exhibiting in other things the most facile credulity. Skepticism, on the other hand, in the original Greek good meaning of the word, is the healthy frame of mind which in all serious questions cares nothing for experience, but everything for arguments. That we have no experience now where the consciousness withdraws to in sleep, true skepticism takes little account of, but rather thoughtfully holds the balancing scales, as this consideration and that are added to either side of the question. When, in addition to the other considerations which we have adduced, the inseparable relations in our life of consciousness and sleep are presented, we are quite willing to leave with such a candid judge the choice, as regards consciousness, between the only two alternatives possible, namely, separate existence or non-existence. Does not sleep testify to the continuance of mind, though as much disassociated from matter, as matter is then disassociated from it, rather than that such a transcendent reality as mind can be regularly both something and nothing?